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Mental Health and Dispositional Predictors of Simultaneous Versus Concurrent Cannabis and Alcohol Use in a Canadian Context

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Objective: Cannabis has become more available in Canada since its legalization in 2018. Many individuals who use cannabis also use alcohol (co-use), which can be used either at the same time such that their effects overlap (simultaneous use) or at different times (concurrent use). Though studies have identified predictors of co-use relative to single-substance use, less is known about the predictors of specific types of co-use. The present study examined the mental health and dispositional predictors of simultaneous relative to concurrent use of the two legal substances (cannabis and alcohol) among adults in Canada. **Method:** Canadian adults reporting past-year use of both cannabis and alcohol (N = 1,761) were recruited from Academic Prolific and six Canadian universities. Participants completed online self-report measures of demographic characteristics, cannabis and alcohol co-use, mental health symptoms, impulsivity, and personality traits. **Results:** Binary logistic regression analyses revealed that when independent variables were each examined individually, greater severity of depression, anxiety, PTSD, and ADHD symptoms; greater negative urgency and lack of premeditation; and greater impulsivity each predicted an increased likelihood of reporting past-year simultaneous use relative to concurrent use. When independent variables were grouped into three separate models (mental health, impulsivity, and personality variables), greater anxiety symptom severity, ADHD symptom severity, negative urgency, and sensation seeking were each uniquely associated with an increased likelihood of simultaneous relative to concurrent use. **Conclusions:** Individuals with elevated anxiety and ADHD symptoms, as well as negative urgency and sensation seeking, may be more inclined to engage in simultaneous use to self-medicate and achieve greater symptom reduction. Future studies may examine the directionality of these relations and motives (e.g., coping) that may differentiate simultaneous and concurrent use.

Key words: = cannabis; alcohol; co-use; simultaneous alcohol and marijuana (SAM); comorbidity; legalization

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Cannabis was legalized for non-medical use in Canada in October 2018 (Cannabis Act, 2018). The legalization of cannabis introduced increased availability of cannabis and greater perceptions of its social acceptability (Health Canada, 2022), potentially contributing to rising prevalence rates of use. Indeed, cannabis use prevalence among Canadian adults rose from 22% in 2017 to 27% in 2022 (Health Canada, 2022), and as of 2019, cannabis was noted as the most used drug in the country (Health Canada, 2023). Alcohol is also one of the most used legal substances in Canada, with 76% of Canadians reporting having consumed alcohol in the past year in 2019 (Health Canada, 2023).

Notably, a substantial proportion of individuals engage in co-use of cannabis and alcohol, a phenomenon whereby both substances are used either at different times (i.e., concurrent use) or the same time and with overlapping effects (i.e., simultaneous use) (Bravo et al., 2021; Yurasek et al., 2017). Although cannabis use and alcohol use are each independently associated with negative consequences (Pearson, 2019; White & Hingson, 2014), these harms are amplified among those who engage in co-use (Yurasek et al., 2017). Indeed, the relative risks of co-use versus single-use of cannabis and alcohol are well-documented (Jackson et al., 2020; Sokolovsky et al., 2020; Thompson et al., 2021; Waddell, 2021), with simultaneous use generally associated with greater negative outcomes relative to concurrent use (Bravo et al., 2021; Jackson et al., 2020; Linden-Carmichael & Wardell, 2021a; Looby et al., 2021; Thompson et al., 2021; Yurasek et al., 2017).

The existing literature has revealed specific consequences associated with different patterns of co-use when examined at the between- and within-person levels. At the between-person level, individuals who engage in simultaneous use have been found to experience more substance-related harms, including problems in social, occupational, financial, and physical domains relative to those who engage in alcohol use only and concurrent use (Lee et al., 2022; Subbaraman & Kerr, 2015). Moreover, those who engage in simultaneous use are more likely to engage in risky driving relative to those who engage in alcohol use only, cannabis use only, and concurrent use (Subbaraman & Kerr, 2015). The within-person consequences of co-use relative to single-substance use are less clear, and few studies have distinguished between simultaneous and concurrent use. However, select daily diary studies have indicated that relative to single-substance use days, days on which cannabis and alcohol are used simultaneously are associated with greater heavier alcohol use (Ito et al., 2021; Lee et al., 2020) and greater negative substance-related consequences (Linden-Carmichael et al., 2020; Sokolovsky et al., 2020; Wardell et al., 2024), as well as with specific consequences such as poorer sleep quality (Graupensperger et al., 2021), greater next-day negative affect (Linden-Carmichael et al., 2021b), risk for sexual assault (Read et al., 2021), and impaired driving (Drohan et al., 2023; Patrick et al., 2021).

Although there is evidence supporting elevated negative consequences of simultaneous relative to concurrent use, particularly at the between-person level, less research attention has been devoted to understanding risk factors for simultaneous relative to concurrent use. Some studies have examined cannabis and alcohol use indicators (e.g., frequency, quantity) and sociodemographic characteristics (e.g., age, gender) as predictors of simultaneous relative to concurrent use (Hatch et al., 2023; Sokolovsky et al., 2020; Subbaraman & Kerr, 2015). However, there is a dearth of research examining the mental health and dispositional factors that distinguish simultaneous from concurrent use, particularly in jurisdictions where both cannabis and alcohol are legal for recreational use.

Single-use of cannabis and alcohol have been linked to symptoms of various common mental health conditions, such as anxiety (Grant et al., 2015; Kedzior & Laeber, 2014; Single et al., 2022), depression (Langlois et al., 2021; McHugh & Weiss, 2019), posttraumatic stress disorder (PTSD; Kevorkian et al., 2015; Lane et al., 2019), and attention-deficit/hyperactivity disorder (ADHD; Francisco et al., 2023; Rooney et al., 2012). Greater depressive symptoms are also associated with greater simultaneous and concurrent use among adults (Midanik et al., 2007). Importantly, previous longitudinal studies suggest that the relations between mental health symptoms and use of these substances appear to be bidirectional and mutually reinforcing, whereby pre-existing mental health conditions lead to elevated risk of problematic cannabis and alcohol use (Bell & Britton, 2014; McGee et al., 2002; Ummels et al., 2022) and vice versa (Bellos et al., 2016; McGee et al., 2002; Ummels et al., 2022). However, the extent to which mental health symptoms may predict engagement in simultaneous versus concurrent use is unclear. It is possible that symptoms of various mental health conditions may be stronger predictors of simultaneous relative to concurrent cannabis and alcohol use. According to the self-medication hypothesis, substance use is often motivated by a desire

to obtain relief from negative affect, such as anxiety and depression (Khantzian, 1997). Individuals with more severe mental health symptoms may therefore be more inclined to use multiple substances at the same time and with overlapping effects in an effort to seek greater relief from their combined effects.

Several dispositional characteristics have also been identified as robust predictors of both cannabis and alcohol use independently. These include dimensions of trait impulsivity, such as negative and positive urgency, sensation seeking, lack of premeditation, and lack of perseverance (Coskunpinar et al., 2013; VanderVeen et al., 2016). Regarding co-use, greater sensation seeking, negative urgency, and positive urgency have been linked to greater likelihood of engaging in both simultaneous (Salguero et al., 2022; Stamates et al., 2023) and concurrent use (Daros et al., 2021; Waddell et al., 2021). However, most studies have generally examined these constructs in relation to just one type of co-use or to single-substance use. Two other dispositional characteristics, hopelessness and anxiety sensitivity, have been identified as influential risk factors for substance use (Woicik et al., 2009) and are positively associated with single use of both cannabis and alcohol (Baines et al., 2016; Newton et al., 2016). Though also likely to play a role in co-use of these two substances, the extent to which they predict engagement in simultaneous versus concurrent use has not yet been tested.

Given the legality and consequent widespread availability of both cannabis and alcohol in Canada, many individuals may be likely to use these substances simultaneously or concurrently. There is a need to identify the characteristics that may render certain individuals more likely to engage in simultaneous versus concurrent use, given that simultaneous use poses greater risk for harms (Linden-Carmichael & Wardell, 2021a; Yurasek et al., 2017). Moreover, previous research has identified differences between individuals who use legal substances relative to illegal substances in demographic and personality characteristics (Fearn et al., 2016; Novais et al., 2016), suggesting that legal context is an influential factor in substance use patterns. Therefore, there is a need to examine risk factors for co-use of cannabis and alcohol in a legal context wherein both substances are widely available. The present study seeks to address this gap by examining the extent to which various common mental health symptoms and dispositional characteristics predict likelihood of engaging in simultaneous relative to concurrent cannabis and alcohol use in a large, combined sample of university-attending and community-dwelling Canadian adults.

Given the dearth of existing research regarding mental health and dispositional predictors of simultaneous relative to concurrent use, the present research was exploratory in nature. However, given that simultaneous cannabis and alcohol use appears to be associated with more severe negative consequences than concurrent use (Lee et al., 2022; Linden-Carmichael et al., 2021b; Patrick et al., 2021; Subbaraman & Kerr, 2015; Sznitman et al., 2023), we expected that certain variables that have been linked to substance use severity more broadly may be more strongly predictive of simultaneous relative to concurrent use. Therefore, the risk factors investigated were informed by the broader substance use literature; specifically, we examined mental health symptoms (i.e., depression, anxiety, social anxiety, posttraumatic stress, and attention-deficit/hyperactivity) and dispositional characteristics (i.e., impulsivity, hopelessness, anxiety sensitivity, and sensation seeking) that, in prior studies, have exhibited positive associations with the intensity of both alcohol (Baines et al., 2016; Castillo-Carniglia et al., 2019; Coskunpinar et al., 2013) and cannabis use (Hasin & Walsh, 2021; Moreno-Mansilla et al., 2021; Paulus et al., 2018; Rinehart & Spencer, 2021).

METHODS

Participants and Procedures

The current study combined data from two subsamples: (1) a community subsample (N= 1089) of Canadian adults recruited from Academic Prolific, an online crowdsourcing platform; and (2) a student subsample (N = 3193) of undergraduate psychology students recruited from psychology student research pools at six Canadian universities (Toronto Metropolitan University, York University, Carleton University, University of British Columbia, University of Calgary, and Mount Saint Vincent University). Eligibility criteria for participants in both subsamples were (i) residing in Canada; and (ii) being of legal drinking age in their respective jurisdiction. To increase confidence in the validity of community participant data, eligibility criteria were preset in the study recruitment notice using age and country of residence filters provided by Academic Prolific, ensuring that only eligible individuals were able to access the study survey. Moreover, participants were asked at the end of the survey to indicate whether they

provided high-quality responses and whether they answered questions honestly; if they responded "no" to either of these items, their data were excluded from analyses.

Of the initial 5990 participants (n = 1088 community; n = 4902 student) who enrolled in the study, 2144 participants (n = 429 community; n = 1715 student) reported past-year use of both cannabis and alcohol. 382 participants (n = 57 community; n = 325 student) reporting past-year cannabis and alcohol use were excluded due to failing attention checks or not confirming having provided honest, high-quality responses to all items, and one additional student participant was excluded due to missing data on items assessing simultaneous use, resulting in a final analytic sample of N = 1761 (n = 372 community; n = 1389 student). Characteristics of each subsample are reported in Table 1. Compared to student participants, community participants were older and more educated and were more likely to identify as male (versus female), more likely to identify as men, less likely to identify as women, more likely to identify as White, less likely to identify as South Asian, more likely to be currently employed, and more likely to be in a relationship (versus single). Community participants also reported greater hopelessness and lower anxiety symptom severity, PTSD symptom severity, ADHD symptom severity, negative urgency, positive urgency, lack of premeditation, sensation seeking, and impulsivity.

Study procedures received ethical approval from the Research Ethics Board at each participating institution. All participants were required to read through a detailed consent form and provide their informed consent prior to accessing the study survey, in which they were informed that they could withdraw their consent at any time and leave any questions blank while still receiving participation credit. Given the online nature of the study, participants were given an unlimited amount of time to read through the consent form and were encouraged to contact the principal investigator via email to ask any questions about the study and their participation. Participants were asked to voluntarily select one of two response options: 1) "I consent to participate in this research;" or 2) "I do not consent to participate in this research." Only those who consented were subsequently directed to complete the study questionnaire. The 45-minute online questionnaire included measures of demographic characteristics, addictive behaviours, mental health, and other psychological variables. Participants received $7.75 CAD (community) or course credit (student) following completion of the online questionnaire.

Measures

Demographic characteristics. Participants reported their age, gender, sex assigned at birth, race/ethnicity, highest level of education, and sexual orientation (see Tables 1 and 2). '

Cannabis and alcohol use. Participants reported whether they had used cannabis in the past year, and if so, during what proportion of their cannabis use occasions they also used alcohol such that the effects of the two substances overlapped. Next, they reported whether they had used alcohol in the past year, and if so, during what proportion of their alcohol use occasions they also used cannabis such that the effects of the two substances overlapped. Response options for both questions were *not at all, some of the time, most of the time,* and *every time*. For analyses, participants were assigned to one of two groups: (1) a *simultaneous use* group, describing participants who used both cannabis and alcohol in the past year and reported any past-year use of the two substances with overlapping effects; or (2) a *concurrent use* group, describing participants who had used both cannabis and alcohol in the past year but reported never, in the past year, having used the two substances with overlapping effects.

Mental health variables. The depression and anxiety subscales from the 21-item Depression, Anxiety, and Stress Scale (DASS-21; Henry & Crawford, 2005) were used to assess depressive and anxiety symptom severity; the seven ordinal items comprising each subscale were summed and multiplied by two to obtain subscale scores (a = .91 and a = .83) for depression and anxiety, respectively, in our sample). Social anxiety symptom severity was assessed using the Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998), consisting of 20 ordinal items that were summed to obtain scores (a = .94). The Short Post-Traumatic Stress Disorder Rating Interview (SPRINT; Connor & Davidson, 2001) was used to assess posttraumatic stress disorder (PTSD) symptom severity; scores were the sum of the eight ordinal items (a = .92). Attention-deficit/hyperactivity disorder (ADHD) symptom severity was assessed using the Adult ADHD Self-Report Scale (ASRS; Kessler et al., 2005), consisting of six ordinal items that were summed to obtain scores (a = .79).

Table 1. *Characteristics of the Community and Student Subsamples*

	Community sample (n = 372)		Student sample (n = 1389)				
	n[a]	n (%)	n[a]	n (%)	$X2$	df	p
Sex	**371**		**1389**		**33.86**	**1.00**	**< .001**
Male		**130 (34.95)**		**284 (20.45)**			
Female		**241 (64.78)**		**1105 (79.55)**			
Gender	**372**		**1389**		**39.00**	—[b]	**< .001**
Woman		**236 (63.44)**		**1051 (75.67)**			
Man		**127 (34.14)**		**273 (19.65)**			
Nonbinary		7 (1.88)		48 (3.46)			
Transgender		0 (0)		2 (0.14)			
Trans woman		1 (0.27)		1 (0.07)			
Trans man		1 (0.27)		10 (0.72)			
Other		0 (0)		4 (0.29)			
Race/ethnicity	**372**		**1389**		**62.78**	**8.00**	**< .001**
Black		8 (2.15)		52 (3.74)			
East Asian		41 (11.02)		180 (12.96)			
Latinx or Hispanic		10 (2.69)		67 (4.82)			
Middle Eastern		7 (1.88)		51 (3.67)			
South Asian		**22 (5.91)**		**191 (13.75)**			
Southeast Asian		13 (3.49)		82 (5.9)			
White		**248 (66.67)**		**627 (45.14)**			
Indigenous		10 (2.69)		30 (2.16)			
Other		13 (3.49)		109 (7.85)			
Sexual identity	372		1389		12.13	—[b]	.096
Straight/heterosexual		259 (69.62)		909 (65.44)			
Gay		6 (1.61)		25 (1.8)			
Bisexual		51 (13.71)		270 (19.44)			
Pansexual		16 (4.3)		57 (4.1)			
Asexual		10 (2.69)		16 (1.15)			
Lesbian		12 (3.23)		41 (2.95)			
Queer		17 (4.57)		60 (4.32)			
Other		1 (0.27)		11 (0.79)			
Highest level of education	**372**		**1389**		**597.42**	**3.00**	**< .001**
High school diploma or less		**28 (7.53)**		**430 (30.96)**			
Some post-secondary education but no college or university degree		**96 (25.81)**		**818 (58.89)**			
College diploma or university degree (Bachelors)		**187 (50.27)**		**139 (10.01)**			

Post-graduate work or degree		**61 (16.4)**		**2 (0.14)**			
Employment status	**372**		**1389**		**788.59**	**2.00**	**< .001**
Not working		**67 (18.01)**		**649 (46.72)**			
Working part-time		**78 (20.97)**		**704 (50.68)**			
Working full-time		**227 (61.02)**		**36 (2.59)**			
Relationship status	**372**		**1389**		**102.81**	**1.00**	**< .001**
Single		**160 (43.01)**		**991 (71.35)**			
In a relationship		**212 (56.99)**		**398 (28.65)**			
Age	**372**	**31.40 (9.21)**	**1389**	**20.46 (3.66)**	**22.42**	**402.90**	**< .001**
DASS-21 depression score	372	13.49 (10.19)	1388	13.50 (10.18)	-0.02	584.98	.987
DASS-21 anxiety score	**372**	**8.77 (7.82)**	**1388**	**11.20 (8.48)**	**-5.23**	**625.16**	**< .001**
SIAS total score	372	34.30 (17.03)	1389	34.63 (16.34)	-0.33	567.28	.741
SPRINT total score	**371**	**10.41 (7.91)**	**1381**	**11.49 (8.05)**	**-2.33**	**592.41**	**.020**
ASRS total score	**372**	**8.87 (4.41)**	**1388**	**9.83 (4.69)**	**-3.65**	**614.28**	**< .001**
SUPPS-P negative urgency score	**372**	**2.40 (0.68)**	**1384**	**2.49 (0.68)**	**-2.31**	**581.45**	**.021**
SUPPS-P positive urgency score	**372**	**1.88 (0.65)**	**1384**	**2.06 (0.65)**	**-4.74**	**588.15**	**< .001**
SUPPS-P lack of premeditation score	**372**	**1.81 (0.56)**	**1382**	**1.97 (0.56)**	**-4.66**	**584.25**	**< .001**
SUPPS-P lack of perseverance score	372	1.87 (0.56)	1384	1.93 (0.54)	-1.80	575.90	.073
SUPPS-P sensation seeking score	**372**	**2.40 (0.69)**	**1381**	**2.60 (0.67)**	**-5.06**	**576.27**	**< .001**
SURPS hopelessness score	**372**	**15.55 (4.36)**	**1385**	**15.02 (3.79)**	**2.14**	**530.75**	**.033**
SURPS anxiety sensitivity score	372	13.25 (2.44)	1385	13.50 (2.51)	-1.73	597.36	.085
SURPS impulsivity score	**372**	**10.42 (2.62)**	**1385**	**11.00 (2.66)**	**-3.78**	**592.94**	**< .001**
SURPS sensation seeking score	**372**	**14.24 (3.58)**	**1385**	**15.45 (3.56)**	**-5.79**	**582.60**	**< .001**

Note. M = mean; *SD* = standard deviation; DASS-21 = Depression, Anxiety, and Stress Scale; SIAS = Social Interaction Anxiety Scale; SPRINT = Short Post-Traumatic Stress Disorder Rating Interview; ASRS = Adult ADHD Self-Report Scale; ADHD = attention deficit hyperactivity disorder; SUPPS-P = Short UPPS-P Impulsive Behavior Scale; SURPS = Substance Use Risk Profile Scale. Total scores for multi-item scales were obtained only for participants who completed all items. Bolding denotes statically significant ($p < .05$) group differences; a Bonferroni adjustment was used to control for type I error inflation in post hoc pairwise comparisons following statistically significant chi-square tests. [a]Denotes number of participants with complete data for each variable; [b]No degrees of freedom reported as *p* value simulated (with 2000 replications) due to small expected value.

Dispositional variables. Five domains of impulsivity (negative urgency, positive urgency, lack of premeditation, lack of perseverance, and sensation seeking) were assessed using the Short UPPS-P Impulsive Behavior Scale (SUPPS-P; Cyders et al., 2014); subscale scores were the mean of the four items comprising each subscale (*a*s = .67-.80). The Substance Use Risk Profile SCALE (SURPS; Woicik et al., 2009) was administered to assess four personality risk factors for substance use: hopelessness (seven items), anxiety sensitivity (five items), impulsivity (five items), and sensation seeking (six items); items comprising each subscale were summed to obtain subscale scores (*a*s = .67-.88).

Data Analysis

Data were analyzed using a series of binary logistic regression models. In each model, the dependent variable was the likelihood of reporting past-year simultaneous use relative to past-year exclusive concurrent use (referent category). First, we specified each mental health and dispositional variable as an independent variable in separate models. Next, mental health and dispositional variables were specified as simultaneous independent variables in three models to examine their unique effects on likelihood of simultaneous use relative to concurrent use; specifically, the mental health variables (depressive symptom severity, anxiety symptom severity, social anxiety symptom severity, PTSD symptom severity, and ADHD symptom severity) were specified as independent variables in model 1, to examine the extent to which symptoms of various common mental health disorders may be uniquely associated with likelihood of engaging in one type of co-use relative to the other. The five SUPPS-P impulsivity domains (negative urgency, positive urgency, lack of premeditation, lack of perseverance, and sensation seeking) were specified as independent variables in model 2, and the four SURPS risk factors (hopelessness, anxiety sensitivity, impulsivity, and sensation seeking) were specified as independent variables in model 3. The SUPPS-P and SURPS measures were entered as independent variables in separate models due to overlap between domains of the SUPPS-P and the impulsivity subscale of the SURPS. For each of these three models, we obtained adjusted *p* values that controlled for the model-wise false discovery rate, reducing risk for type I error inflation. In all models, we controlled for a subsample indicator (0 = community, 1 = student), age (in years), and sex (0 = male, 1 = female), race (0 = White, 1 = non-White, sexual identity (0 = straight/heterosexual; 1 = Lesbian, Gay, Bisexual, Queer+), and relationship status (0 = single, 1 = in a relationship).[1] The binary logistic regression models were fit using iteratively reweighted least squares estimation.

The proportion of participants who were missing data on one or more scale items ranged from 0–0.57% across variables; however, when participants had data on 80% or more of the items comprising a given scale, their missing item values were prorated using available items, resulting in variable-level missingness ranging from 0–0.51%. To include data from participants with partially missing data on independent variables, missing data were handled using multiple imputation via the multiple imputation by chained equations (MICE) approach; predictive mean matching was used to impute missing values for continuous variables, and logistic regression was used to impute missing values for binary variables. All models were fit separately to each of 50 imputed datasets, after which estimates were pooled.

All analyses were conducted in R (R Core Team, 2022) using the *mice, misty, stats,* and *tidyverse* packages (R Core Team, 2022; van Buure & Groothuis-Oudshoorn, 2011; Wickham et al., 2019; Yanagida, 2022). Data and code for analyses are available at https://osf.io/9dq53/.

RESULTS

Table 2 presents characteristics of the full sample and of each co-use group. One thousand and ninety-seven participants (62.29%) reported past-year simultaneous use, and 664 participants (37.71%) reported past-year concurrent use.

Results of binary logistic regression models with each independent variable of interest in a separate model are shown in Table 3. In these models, greater depressive, anxiety, PTSD, and negative urgency, positive urgency, lack of premeditation, and sensation seeking on the SUPPS-P; and greater impulsivity and sensation seeking on the SURPS were each significantly associated with an increased likelihood of simultaneous use relative to concurrent use.

[1]Gender was not included in models as a covariate due to high overlap with sex, and employment status and highest level of education were not included in models as covariates due to high overlap with subsample.

Table 2. *Characteristics of the Full Sample and of Participants Reporting Past-Year Concurrent Use and Past-Year Simultaneous Use*

	Full sample (n = 1761)		Concurrent use (n = 664)		Simultaneous use (n = 1097)	
	n[a]	n (%)	n[a]	n (%)	n[a]	n (%)
Sex	1760		663		1097	
Male		414 (23.51)		140 (21.08)		274 (24.98)
Female		1346 (76.43)		523 (78.77)		823 (75.02)
Gender	1761		664		1097	
Woman		1287 (73.08)		504 (75.9)		783 (71.38)
Man		400 (22.71)		133 (20.03)		267 (24.34)
Nonbinary		55 (3.12)		23 (3.46)		32 (2.92)
Transgender		2 (0.11)		0 (0)		2 (0.18)
Trans woman		2 (0.11)		2 (0.3)		0 (0)
Trans man		11 (0.62)		2 (0.3)		9 (0.82)
Other		4 (0.23)		0 (0)		4 (0.36)
Race/ethnicity	1761		664		1097	
Black		60 (3.41)		24 (3.61)		36 (3.28)
East Asian		221 (12.55)		103 (15.51)		118 (10.76)
Latinx or Hispanic		77 (4.37)		37 (5.57)		40 (3.65)
Middle Eastern		58 (3.29)		27 (4.07)		31 (2.83)
South Asian		213 (12.1)		98 (14.76)		115 (10.48)
Southeast Asian		95 (5.39)		36 (5.42)		59 (5.38)
White		875 (49.69)		293 (44.13)		582 (53.05)
Indigenous		40 (2.27)		9 (1.36)		31 (2.83)
Other		122 (6.93)		37 (5.57)		85 (7.75)
Sexual identity	1761		664		1097	
Straight/heterosexual		1168 (66.33)		444 (66.87)		724 (66)
Gay		31 (1.76)		11 (1.66)		20 (1.82)
Bisexual		321 (18.23)		112 (16.87)		209 (19.05)
Pansexual		73 (4.15)		26 (3.92)		47 (4.28)
Asexual		26 (1.48)		15 (2.26)		11 (1)
Lesbian		53 (3.01)		19 (2.86)		34 (3.1)
Queer		77 (4.37)		32 (4.82)		45 (4.1)
Other		12 (0.68)		5 (0.75)		7 (0.64)
Highest level of education	1761		664		1097	
High school diploma or less		458 (26.01)		174 (26.2)		284 (25.89)
Some post-secondary education but no college or university degree		914 (51.9)		323 (48.64)		591 (53.87)

College diploma or university degree (Bachelors)		326 (18.51)		135 (20.33)		191 (17.41)
Post-graduate work or degree		63 (3.58)		32 (4.82)		31 (2.83)
Employment status	1761		664		1097	
Not working		716 (40.66)		262 (39.46)		454 (41.39)
Working part-time		782 (44.41)		304 (45.78)		478 (43.57)
Working full-time		263 (14.93)		98 (14.76)		165 (15.04)
Relationship status	1761		664		1097	
Single		1151 (65.36)		438 (65.96)		713 (65)
In a relationship		610 (34.64)		226 (34.04)		384 (35)
Age	1761	22.77 (6.96)	664	22.73 (6.75)	1097	22.80 (7.09)
DASS-21 depression score	1760	13.49 (10.18)	663	12.51 (10.16)	1097	14.09 (10.15)
DASS-21 anxiety score	1760	10.69 (8.40)	663	9.66 (8.19)	1097	11.30 (8.47)
SIAS total score	1761	34.56 (16.48)	664	34.51 (16.75)	1097	34.59 (16.32)
SPRINT total score	1752	11.26 (8.03)	661	10.62 (8.04)	1091	11.65 (8.01)
ASRS total score	1760	9.63 (4.65)	663	8.98 (4.72)	1097	10.02 (4.56)
SUPPS-P negative urgency score	1756	2.48 (0.68)	662	2.41 (0.66)	1094	2.51 (0.69)
SUPPS-P positive urgency score	1756	2.02 (0.65)	662	1.99 (0.67)	1094	2.04 (0.64)
SUPPS-P lack of premeditation score	1754	1.93 (0.57)	659	1.90 (0.56)	1095	1.96 (0.57)
SUPPS-P lack of perseverance score	1756	1.91 (0.55)	662	1.90 (0.56)	1094	1.92 (0.54)
SUPPS-P sensation seeking score	1753	2.56 (0.68)	660	2.48 (0.67)	1093	2.60 (0.68)
SURPS hopelessness score	1757	15.13 (3.92)	663	14.98 (3.82)	1094	15.22 (3.98)
SURPS anxiety sensitivity score	1757	13.45 (2.49)	663	13.32 (2.46)	1094	13.52 (2.51)
SURPS impulsivity score	1757	10.88 (2.66)	663	10.68 (2.71)	1094	10.99 (2.62)
SURPS sensation seeking score	1757	15.19 (3.59)	663	14.82 (3.48)	1094	15.42 (3.64)

Note. M = mean; *SD* = standard deviation; DASS-21 = Depression, Anxiety, and Stress Scale; SIAS = Social Interaction Anxiety Scale; SPRINT = Short Post-Traumatic Stress Disorder Rating Interview; ASRS = Adult ADHD Self-Report Scale; ADHD = attention deficit hyperactivity disorder; SUPPS-P = Short UPPS-P Impulsive Behavior Scale; SURPS = Substance Use Risk Profile Scale. Total scores for multi-item scales were obtained only for participants who completed all items. [a]Denotes number of participants with complete data for each varable.

Table 3. *Results of Binary Logistic Regression Models Predicting Likelihood of Simultaneous Use Relative to Concurrent Use with Each Independent Variable of Interest in a Separate Model*

Model	Variable	OR	Estimate	*SE*	*p*
IV of interest: Depressive symptom severity					
	DASS-21 depressive symptom severity	**1.02**	**0.02**	**0.01**	**0.001**
	Subsample (0 = community, 1 = student)	1.33	0.29	0.16	0.073
	Age	1.00	0.00	0.01	0.660
	Sex (0 = male, 1 = female)	**0.75**	**-0.29**	**0.12**	**0.016**
	Race (0 = White, 1 = non-White)	**0.67**	**-0.40**	**0.10**	**< 0.001**
	Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	1.00	0.00	0.11	0.990
	Relationship status (0 = single, 1 = relationship)	1.05	0.04	0.11	0.684
IV of interest: Anxiety symptom severity					
	DASS-21 anxiety symptom severity	**1.03**	**0.03**	**0.01**	**< 0.001**
	Subsample (0 = community, 1 = student)	1.28	0.25	0.16	0.122
	Age	1.01	0.01	0.01	0.488
	Sex (0 = male, 1 = female)	**0.71**	**-0.34**	**0.12**	**0.005**
	Race (0 = White, 1 = non-White)	**0.68**	**-0.38**	**0.10**	**< 0.001**
	Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	0.98	-0.02	0.11	0.831
	Relationship status (0 = single, 1 = relationship)	1.02	0.02	0.11	0.871
IV of interest: Social anxiety symptom severity					
	SIAS social anxiety symptom severity	1.00	0.00	0.00	0.853
	Subsample (0 = community, 1 = student)	1.31	0.27	0.16	0.094
	Age	1.00	0.00	0.01	0.719
	Sex (0 = male, 1 = female)	**0.76**	**-0.28**	**0.12**	**0.024**
	Race (0 = White, 1 = non-White)	**0.68**	**-0.39**	**0.10**	**< 0.001**
	Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	1.05	0.05	0.11	0.641
	Relationship status (0 = single, 1 = relationship)	1.03	0.03	0.11	0.789
IV of interest: PTSD symptom severity					
	SPRINT PTSD symptom severity	**1.02**	**0.02**	**0.01**	**0.002**
	Subsample (0 = community, 1 = student)	1.28	0.25	0.16	0.119
	Age	1.00	0.00	0.01	0.795
	Sex (0 = male, 1 = female)	**0.72**	**-0.33**	**0.12**	**0.008**
	Race (0 = White, 1 = non-White)	**0.67**	**-0.40**	**0.10**	**< 0.001**
	Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	1.00	0.00	0.11	0.997
	Relationship status (0 = single, 1 = relationship)	1.04	0.04	0.11	0.743
IV of interest: ADHD symptom severity					
	ASRS ADHD symptom severity	**1.05**	**0.05**	**0.01**	**< 0.001**
	Subsample (0 = community, 1 = student)	1.28	0.24	0.16	0.130
	Age	1.00	0.00	0.01	0.614
	Sex (0 = male, 1 = female)	**0.71**	**-0.34**	**0.12**	**0.005**
	Race (0 = White, 1 = non-White)	**0.68**	**-0.38**	**0.10**	**< 0.001**
	Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	0.98	-0.02	0.11	0.823
	Relationship status (0 = single, 1 = relationship)	1.02	0.02	0.11	0.863
IV of interest: SUPPS-P negative urgency					
	SUPPS-P negative urgency	**1.27**	**0.24**	**0.07**	**0.001**
	Subsample (0 = community, 1 = student)	1.31	0.27	0.16	0.091
	Age	1.01	0.01	0.01	0.588
	Sex (0 = male, 1 = female)	**0.75**	**-0.28**	**0.12**	**0.020**
	Race (0 = White, 1 = non-White)	**0.66**	**-0.41**	**0.10**	**< 0.001**
	Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	1.01	0.01	0.11	0.915
	Relationship status (0 = single, 1 = relationship)	1.03	0.03	0.11	0.814
IV of interest: SUPPS-P positive urgency					
	SUPPS-P positive urgency	**1.17**	**0.15**	**0.08**	**0.049**

Subsample (0 = community, 1 = student)	1.29	0.26	0.16	0.108
Age	1.00	0.00	0.01	0.616
Sex (0 = male, 1 = female)	**0.77**	**-0.26**	**0.12**	**0.036**
Race (0 = White, 1 = non-White)	**0.66**	**-0.41**	**0.10**	**< 0.001**
Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	1.05	0.05	0.11	0.665
Relationship status (0 = single, 1 = relationship)	1.03	0.03	0.11	0.794
IV of interest: SUPPS-P lack of premeditation				
SUPPS-P lack of premeditation	**1.22**	**0.20**	**0.09**	**0.026**
Subsample (0 = community, 1 = student)	1.29	0.25	0.16	0.115
Age	1.00	0.00	0.01	0.649
Sex (0 = male, 1 = female)	**0.74**	**-0.30**	**0.12**	**0.016**
Race (0 = White, 1 = non-White)	**0.67**	**-0.39**	**0.10**	**< 0.001**
Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	1.04	0.04	0.11	0.722
Relationship status (0 = single, 1 = relationship)	1.04	0.04	0.11	0.745
IV of interest: SUPPS-P lack of perseverance				
SUPPS-P lack of perseverance	1.13	0.12	0.09	0.186
Subsample (0 = community, 1 = student)	1.31	0.27	0.16	0.094
Age	1.00	0.00	0.01	0.703
Sex (0 = male, 1 = female)	**0.75**	**-0.28**	**0.12**	**0.021**
Race (0 = White, 1 = non-White)	**0.67**	**-0.40**	**0.10**	**< 0.001**
Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	1.05	0.05	0.11	0.664
Relationship status (0 = single, 1 = relationship)	1.04	0.04	0.11	0.737
IV of interest: SUPPS-P sensation seeking				
SUPPS-P sensation seeking	**1.29**	**0.25**	**0.08**	**0.001**
Subsample (0 = community, 1 = student)	1.24	0.22	0.16	0.173
Age	1.00	0.00	0.01	0.637
Sex (0 = male, 1 = female)	0.84	-0.18	0.13	0.151
Race (0 = White, 1 = non-White)	**0.67**	**-0.41**	**0.10**	**< 0.001**
Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	1.09	0.09	0.11	0.415
Relationship status (0 = single, 1 = relationship)	1.04	0.04	0.11	0.718
IV of interest: SURPS hopelessness				
SURPS hopelessness	1.02	0.02	0.01	0.146
Subsample (0 = community, 1 = student)	1.32	0.28	0.16	0.079
Age	1.00	0.00	0.01	0.734
Sex (0 = male, 1 = female)	**0.76**	**-0.27**	**0.12**	**0.026**
Race (0 = White, 1 = non-White)	**0.67**	**-0.40**	**0.10**	**< 0.001**
Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	1.03	0.03	0.11	0.805
Relationship status (0 = single, 1 = relationship)	1.04	0.04	0.11	0.705
IV of interest: SURPS anxiety sensitivity				
SURPS anxiety sensitivity	1.04	0.04	0.02	0.055
Subsample (0 = community, 1 = student)	1.31	0.27	0.16	0.086
Age	1.00	0.00	0.01	0.636
Sex (0 = male, 1 = female)	**0.73**	**-0.32**	**0.12**	**0.010**
Race (0 = White, 1 = non-White)	**0.68**	**-0.39**	**0.10**	**< 0.001**
Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	1.03	0.03	0.11	0.750
Relationship status (0 = single, 1 = relationship)	1.02	0.02	0.11	0.840
IV of interest: SURPS impulsivity				
SURPS impulsivity	**1.05**	**0.05**	**0.02**	**0.007**
Subsample (0 = community, 1 = student)	1.30	0.26	0.16	0.101
Age	1.01	0.00	0.01	0.601
Sex (0 = male, 1 = female)	**0.77**	**-0.27**	**0.12**	**0.029**
Race (0 = White, 1 = non-White)	**0.66**	**-0.42**	**0.10**	**< 0.001**
Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	1.04	0.04	0.11	0.696
Relationship status (0 = single, 1 = relationship)	1.04	0.04	0.11	0.718

IV of interest: SURPS sensation seeking				
SURPS sensation seeking	**1.05**	**0.05**	**0.01**	**0.002**
Subsample (0 = community, 1 = student)	1.25	0.22	0.16	0.167
Age	1.00	0.00	0.01	0.609
Sex (0 = male, 1 = female)	0.82	-0.20	0.12	0.109
Race (0 = White, 1 = non-White)	**0.67**	**-0.40**	**0.10**	**< 0.001**
Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	1.06	0.06	0.11	0.565
Relationship status (0 = single, 1 = relationship)	1.04	0.04	0.11	0.707

Note. OR = odds ratio; *SE* = standard error; IV = independent variable; DASS-21 = Depression, Anxiety, and Stress Scale; LGBQ+ = Lesbian, Gay, Bisexual, Queer+; SIAS = Social Interaction Anxiety Scale; SPRINT = Short Post-Traumatic Stress Disorder Rating Interview; PTSD = posttraumatic stress disorder; ASRS = Adult ADHD Self-Report Scale; ADHD = attention deficit hyperactivity disorder; SUPPS-P = Short UPPS-P Impulsive Behavior Scale; SURPS = Substance Use Risk Profile Scale. Bolding indicates statistical significance at $a = .05$.

Results of binary logistic regression models with each independent variable of interest combined into three separate models are shown in Table 4. In the model with all mental health variables as independent variables (model 1), greater anxiety symptom severity, social anxiety symptom severity, and ADHD symptom severity were each significantly and uniquely associated with an increased likelihood of simultaneous use relative to concurrent use, although the association of anxiety symptom severity with likelihood of simultaneous use relative to concurrent use was no longer statistically significant after correcting for the false discovery rate. In the model with all impulsivity facets as independent variables (model 2), greater negative urgency and sensation seeking were each significantly and uniquely associated with an increased likelihood of simultaneous use relative to concurrent use. In the model with all personality risk factors as independent variables (model 3), greater sensation seeking was significantly and uniquely associated with an increased likelihood of simultaneous use relative to concurrent use.

Table 4. *Results of Binary Logistic Regression Models Predicting Likelihood of Simultaneous Use Relative to Concurrent Use with Independent Variables of Interest Combined into Three Models*

Model	Variable	OR	Estimate	*SE*	*p*	p_{adj}
Model 1: Mental health variables as IVs of interest						
	DASS-21 depressive symptom severity	1.00	0.00	0.01	0.652	0.896
	DASS-21 anxiety symptom severity	**1.02**	**0.02**	**0.01**	**0.036**	0.079
	SIAS social anxiety symptom severity	**0.99**	**-0.01**	**0.00**	**0.009**	**0.025**
	SPRINT PTSD symptom severity	1.01	0.01	0.01	0.497	0.782
	ASRS ADHD symptom severity	**1.04**	**0.04**	**0.01**	**0.002**	**0.010**
	Subsample (0 = community, 1 = student)	1.22	0.20	0.16	0.225	0.412
	Age	1.00	0.00	0.01	0.718	0.878
	Sex (0 = male, 1 = female)	**0.71**	**-0.34**	**0.13**	**0.007**	**0.025**
	Race (0 = White, 1 = non-White)	**0.67**	**-0.40**	**0.10**	**<0.001**	**0.001**
	Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	0.98	-0.02	0.11	0.832	0.916
	Relationship status (0 = single, 1 = relationship)	1.02	0.02	0.11	0.875	0.875
Model 2: Impulsivity facets as IVs of interest						
	SUPPS-P negative urgency	**1.28**	**0.24**	**0.09**	**0.008**	**0.029**
	SUPPS-P positive urgency	0.90	-0.10	0.10	0.303	0.476
	SUPPS-P lack of premeditation	1.11	0.10	0.11	0.340	0.468
	SUPPS-P lack of perseverance	1.12	0.11	0.11	0.293	0.537
	SUPPS-P sensation seeking	**1.31**	**0.27**	**0.08**	**0.001**	**0.006**
	Subsample (0 = community, 1 = student)	1.25	0.22	0.16	0.168	0.369

Age	1.01	0.01	0.01	0.505	0.617
Sex (0 = male, 1 = female)	0.81	-0.22	0.13	0.088	0.243
Race (0 = White, 1 = non-White)	**0.66**	**-0.42**	**0.10**	**<0.001**	**0.001**
Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	1.04	0.04	0.11	0.745	0.745
Relationship status (0 = single, 1 = relationship)	1.05	0.05	0.11	0.666	0.732
Model 3: Personality risk factors as IVs of interest					
SURPS hopelessness	1.02	0.02	0.01	0.198	0.330
SURPS anxiety sensitivity	1.04	0.04	0.02	0.073	0.182
SURPS impulsivity	1.03	0.03	0.02	0.203	0.290
SURPS sensation seeking	**1.05**	**0.05**	**0.02**	**0.002**	**0.008**
Subsample (0 = community, 1 = student)	1.27	0.24	0.16	0.137	0.273
Age	1.01	0.01	0.01	0.460	0.575
Sex (0 = male, 1 = female)	0.79	-0.23	0.13	0.068	0.228
Race (0 = White, 1 = non-White)	**0.66**	**-0.41**	**0.10**	**<0.001**	**0.001**
Sexual identity (0 = straight/heterosexual, 1 = LGBQ+)	1.01	0.01	0.11	0.927	0.927
Relationship status (0 = single, 1 = relationship)	1.05	0.05	0.11	0.635	0.706

Note. OR = odds ratio; *SE* = standard error; p_{adj} = adjusted *p* value after correcting for the false discovery rate; IV = independent variable; DASS-21 = Depression, Anxiety, and Stress Scale; SIAS = Social Interaction Anxiety Scale; SPRINT = Short Post-Traumatic Stress Disorder Rating Interview; PTSD = posttraumatic stress disorder; ASRS = Adult ADHD Self-Report Scale; ADHD = attention deficit hyperactivity disorder; LGBQ+ = Lesbian, Gay, Bisexual, Queer+; SUPPS-P = Short UPPS-P Impulsive Behavior Scale; SURPS = Substance Use Risk Profile Scale. Bolding indicates statistical significance at *a* = .05.

DISCUSSION

The present study sought to elucidate the mental health and dispositional predictors of simultaneous relative to concurrent cannabis and alcohol use in a Canadian context, wherein both substances are legal for recreational use. When independent variables were examined individually, more severe depression, anxiety, PTSD, and ADHD symptoms; greater overall impulsivity; and greater negative urgency, positive urgency, sensation seeking, and lack of premeditation were each associated with a greater likelihood of reporting simultaneous relative to concurrent use. When independent variables were grouped into three models (mental health, impulsivity, and personality traits), anxiety symptoms, ADHD symptoms, negative urgency, and sensation seeking remained significant predictors of simultaneous relative to concurrent use.

Symptoms of various common mental health disorders, including those of anxiety and ADHD, were expected to predict greater simultaneous relative to concurrent cannabis and alcohol use. In line with the self-medication hypothesis of substance use (Khantzian, 1997), individuals with elevated symptoms of these disorders may be inclined to use substances to cope with and reduce the intensity of their symptoms—a goal they may expect to be more rapidly achieved if they use multiple substances at the same time for their additive effects. Indeed, the findings that both anxiety and ADHD symptoms predicted greater simultaneous relative to concurrent use in the present study appear to support this notion. Moreover, cross-fading motives, which refer to using cannabis and alcohol at the same time to enhance the effects of each substance, are frequently endorsed by individuals who engage in simultaneous use (Patrick et al., 2020). Individuals with elevated anxiety symptoms may be drawn to use both cannabis and alcohol due to their perceived anxiolytic effects (Gilman et al., 2008; Sharpe et al., 2020). Cannabis is often used to relax (Patrick et al., 2016) and to cope with distress (Ouellette et al., 2022), and some report a subjective decrease in anxiety following use (Cuttler et al., 2018). Alcohol is also often consumed for its tension-reducing properties (Abrams et al., 2021; Pabst et al., 2014), and its acute impairment of cognitive processes such as inhibitory control and attention (Field et al., 2010) may be sought by some individuals to aid in temporarily disengaging from worry and anxiety.

Individuals with elevated ADHD symptoms may similarly engage in simultaneous cannabis and alcohol use to reduce distress associated with their symptoms (Smith et al., 2002). Indeed, some individuals with ADHD report experiencing enhanced positive mood following substance use (Mitchell et al., 2017) and using substances to be perceived as "normal" and to achieve a greater sense of social belongingness (Nehlin et al., 2014). Existing evidence suggests potential additive effects of cannabis and alcohol (Yurasek et al., 2017), with simultaneous use producing greater subjective relief than alcohol-only use (Waddell et al., 2023). Thus, consistent with the self-medication hypothesis (Khantzian, 1997), simultaneous use may be particularly attractive to individuals with elevated anxiety and ADHD symptoms as a tool for managing their distress.

Several dimensions of impulsivity were also explored as risk factors for simultaneous relative to concurrent use in the present study, with negative urgency and sensation seeking identified as significant predictors. Individuals high in sensation seeking tend to endorse a need to seek novel, risky, and exciting experiences (Lynne-Landsman et al., 2011) and may thus be inclined to fulfill this need by combining cannabis and alcohol use to achieve enhanced or intensified psychoactive effects (i.e., cross-fading motives; Patrick et al., 2020). On the other hand, individuals high in negative urgency may be inclined to combine cannabis and alcohol use to obtain greater relief from the negative affect they are experiencing in the moment. This possibility is aligned with findings of a previous study indicating that the daily-level relationship between quantity of cannabis and alcohol consumed was stronger for individuals high but not low in negative urgency, suggesting that participants with elevated levels of this trait may be more likely to use these substances simultaneously for their complementary effects (Daros et al., 2022). That these two facets of impulsivity were each associated with a greater likelihood of simultaneous relative to concurrent cannabis and alcohol use also appears to be consistent with the broader co-use literature. Previous work has identified a positive association between both sensation seeking (Waddell et al., 2021) and negative urgency (Rothstein et al., 2023) with co-use, though these studies did not differentiate between simultaneous and concurrent use. Findings of the present study suggest that these facets of impulsivity may be particularly influential in the decision to use cannabis and alcohol at the same time rather than separately.

Given that individuals with elevated anxiety and ADHD symptoms appear to be at greater risk of engaging in simultaneous use, they may benefit from psychoeducation, perhaps involving information about potential motives for and consequences of simultaneous use, mental health symptoms (e.g., anxiety, ADHD), and more adaptive strategies for coping with distress associated with these symptoms (McKee, 2017). This information may help individuals to be better informed about their decision to engage (or not engage) in simultaneous use. Elements of cognitive-behavioural therapy may also be integrated to help clients to implement effective coping and emotion regulation strategies that reduce their likelihood of engaging in simultaneous use to manage distress (McKee, 2017). Dialectical behaviour therapy (DBT; Linehan, 2015) skills may be a beneficial addition for individuals who endorse elevated sensation seeking and negative urgency, as they have been shown to lead to reductions in impulsivity among individuals with substance use disorders (Cavicchioli et al., 2023). Given the relatively small effect sizes observed for these predictors, however, future research should seek to replicate the present findings to provide greater support for these recommendations.

Interestingly, none of the other dimensions of impulsivity tested in the present study—including positive urgency, lack of premeditation, and lack of perseverance—were identified as significant predictors of simultaneous versus concurrent use when included alongside other predictors. It is particularly interesting that negative, but not positive, urgency significantly predicted greater likelihood of simultaneous relative to concurrent use, as this suggests that simultaneous use may be more strongly influenced by negative than positive emotion. This is consistent with several studies in the broader substance use literature, which have found that negative urgency is a stronger predictor of problematic alcohol use (Willie et al., 2022) and alcohol use consequences than is positive urgency (Grimaldi et al., 2014). In addition to the null findings related to several

facets of impulsivity, neither anxiety sensitivity nor hopelessness significantly differentiated simultaneous use from concurrent use. It is possible that these dispositional traits contribute to cannabis use and alcohol use (Baines et al., 2016; Newton et al., 2016; Woicik et al., 2009) and to co-use in general, but do not differentiate between specific types of co-use. However, this interpretation is speculative and warrants empirical testing.

Limitations

Our cross-sectional design precludes causal inferences. Longitudinal data are needed to confirm the directions of associations observed. Further, concurrent use was broadly defined as having used both cannabis and alcohol within the past year. Whether results would generalize to narrower definitions of concurrent use (e.g., use of both within the same month, week, or day) remains unknown. Our focus on two community samples may also limit the generalizability of results to clinical samples of adults seeking treatment for cannabis or alcohol use problems. In particular, there are known limitations associated with online research panel data sources such as Academic Prolific, including concerns regarding data quality, financial incentives motivating the provision of inaccurate data, and difficulty generalizing results due to discordance between characteristics of the sample and those of the broader population of interest (Borodovsky, 2023; Chandler et al., 2022). Importantly, however, Academic Prolific has been found to yield higher-quality data relative to other frequently used online research panels such as Amazon's Mechanical Turk, as evidenced by Academic Prolific participants being more likely to pass attention checks, provide meaningful answers, and adhere to instructions (Douglas et al., 2023). Nonetheless, the present study should be replicated in more representative samples recruited from various sources to provide additional confidence in its findings.

Conclusions

In sum, this study extends prior research on cannabis-alcohol co-use by examining factors differentiating individuals reporting simultaneous use from those reporting exclusively concurrent use. Results suggest that higher anxiety and ADHD symptom severity increase the likelihood of using cannabis and alcohol simultaneously, with overlapping effects, relative to separately, suggesting that symptoms of these common mental health conditions represent important risk factors for a particularly harmful form of co-use. Future research should examine potential mechanisms of the mental health factors differentiating simultaneous from concurrent use, such as co-use motives, and should employ longitudinal designs to determine the directions of the associations observed.

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